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Climate Change and Food Security in Pacific Island Countries

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I. INTRODUCTION

The overall purpose of this paper is to address food security and poverty reduction in the face of climate change and energy security. It attempts to bring to the fore food security threats associated with climate change in the food production and supply environments, as well as the broader livelihood and ecological changes that will occur as a consequence. Recognizing the different geographical regions around the Pacific and how climate change would impact on their food security situations opens up new opportunities for understanding why changes happen. An attempt will also be made to address the question; how can Pacific Islanders be assisted to enhance their capacity to reduce risk and make optimal use of current climate resources in order to capitalize on benefits that may arise due to the changing climate. In doing so, it will attempt to highlight some of the current impacts of climate change reported by Pacific Island countries in their national communications to the UNFCCC and their National Adaptation Programmes of Action (NAPAs), and what attempts have been made to seriously address these issues. It is recognized that climate change is an additional stress that needs to be managed by the agricultural and broader development communities but it should also be emphasized that climate change will further exacerbate current development stresses that are already plaguing the agriculture community and national governments. This paper will try to draw out these links and discuss ways to proactively address the situation now rather than later.

Pacific Island Countries and Territories (PICTs) comprise a land area of only 553,959 km² spread in the world's largest ocean, with Papua New Guinea (PNG) accounting for 83% of the land area. The population is predominantly rural; however, urbanization is rapid, resulting in more than 40% of the population residing in urban areas in a few countries (SPC, 2004). Climate associated disasters such as tropical cyclones, flash floods and droughts impose serious constraints on development in the islands, so much so that some PICTs seem to be in "constant mode of recovery". Food availability and people's accessibility to food are amongst the first to be affected following such disasters. It seems obvious that any significant change in climate on a global scale will impact local agriculture, and therefore affect the world's food supply. In a changing climate regime, the need to strengthen food security¹ is, therefore, paramount.

Addressing the challenges of food security by taking into account current and future changes in climate is critical to reducing poverty and food insecurity. Food security assessments carried out in four Pacific countries (Fiji, PNG, Tonga and Vanuatu) by the CGPRT Centre (2000) showed that provincial and household food securities are of more serious concern than national food security. Food security systems in rural areas are mainly natural resources based while urban areas are more dependent on imported food.

The eradication of poverty and hunger is one of the United Nations Millennium Development Goals adopted in the year 2000. One of the targets of the Goals is to halve the proportion of people who suffer from hunger, in the timeframe 1990 and 2015. New information from the Intergovernmental Panel on Climate Change (IPCC) points to the fact that climate change is a phenomenon that would seriously threaten current food security situations globally, and jeopardize governments' ability to deliver on their MDG goals. Not only that, it also poses further risk in shifting development priorities from land for food security to biofuel and "green oil" production in light of high fossil fuel prices in the international market².

¹ As defined by the FAO (Food and Agriculture Organization of the United Nations), *food security* refers to a condition for all people, at all times, having both physical, social and economic access to sufficient, safe and healthy variety of food, satisfying dietary needs and food preferences while having an active and healthy life in a sustainable manner.

² Currently priced at approximately USD100/barrel

It is also critical also to address the dichotomy between land and coastal zone management for food security and the Clean Development Mechanism³. The use of arable land for growing green oil and biofuel is already taking place in one country in the region, PNG. If it will expand to other islands with a quarter of PNG's landmass in an unsustainable way, serious food security issues may arise. Related to the above are the issues of afforestation⁴ and reforestation⁵, a mechanism for carbon substitution and sequestration/reduction currently being deliberated in the climate change negotiations of the United Nations Framework Convention on Climate Change (UNFCCC).

II. CLIMATE CHANGE IN THE PACIFIC

The Fourth Assessment Report of the IPCC (IPCC AR4) Working Group II (2007) identifies small island states as being among the most vulnerable countries of the world to the adverse impacts of climate change. Hay *et al* (2003) in discussing the Pacific's observed climate noted that compared to earlier historical records during the 20th century, the southern Pacific had experienced a significantly drier and warmer climate (by 15% and 0.8^o C, respectively). The Central Equatorial Pacific is facing more intensive rain (about 30%) and a similarly hotter climate (0.6^o C), and sea surface temperatures in both areas have increased by about 0.4^o C. These conditions are linked to an increased frequency of El Niño episodes since the 1970s (without alternating La Niña events). Other studies show that climate projections for the South Pacific indicate warming of 0.8 to 1.8^oC and precipitation changes that range from -8 to +7 per cent by mid-century (Ruosteenoja *et al.*, 2003). By the end of the century, projected warming is 1.0 to 3.1^oC and precipitation changes range from -14 to +14 percent. Projections of globally averaged sea level rise range from 0.18m to 0.58m in 2090-2099 relative to 1980-1999; while tropical cyclones are likely to become more intense, have higher peak wind speeds, and bring heavier rainfall (IPCC, 2007). Thus it is clear that there are winners and losers when it comes to climate and food security; mostly the countries in the mid to higher latitudes benefiting from global warming, the small island countries of the Pacific in the warmer latitudes standing to lose much. The IPCC has concluded that the mounting evidence shows that climate change is unequivocally happening and may worsen in future; there is a need to act urgently to minimize these impacts.

Pacific Island countries because of their unique geophysical features, social, economic and unique cultural characteristics are particularly vulnerable to the effects of global warming, including more frequent and intense natural disasters, such as cyclones, floods and land droughts - as has recently been experienced. In the 1990s, for example, the cost of extreme events in the Pacific Island region is estimated to have exceeded US\$1 billion (Bettencourt and Warrick, 2000). This included the cost of Cyclones Ofa and Val, which hit Samoa in 1990/91, causing losses of US\$440 million, which was greater than the country's average annual gross domestic product (GDP) in recent years. In Niue, Cyclone Heta is estimated to have caused an impact of about NZ\$37.7 million, which is approximately 25% of its GDP (McKenzie *et al.*, 2005). In February 2008, Fiji incurred in excess of FJ\$45 million in damages to agriculture (excluding the sugar industry), infrastructure, utilities and properties as a result of Cyclone Gene. In addition, the Government had to provide FJ\$1.7 million worth of food rations (ReliefWeb, 2008).

³ Established under the Kyoto Protocol to market carbon credits accrued from sustainable development projects in developing countries, and to sell these to developed countries falling short of their Kyoto targets

⁴ Planting of new forests on lands that historically have not contained forests

⁵ Replanting of forests on lands that have previously contained forests but that have been converted to some other use.

III. PACIFIC FOOD SOURCES AND WATER

Food sources⁶ in PICTs are similar to sources of food in other parts of world. This section is focused on the present and projected climate impacts on the major food sources; and not on how these food sources contribute to climate change. Drinking water is included because of its close linkages to food and nutrition. The analysis presented here is based on available information in the literature and the expert judgment of the authors. The key constraint in this analysis is the lack thereof and limited information on in-depth analysis of climate change impacts on the food sources of PICTs.

Agriculture

The Governments of some Pacific Islands, in particular the larger islands, have embraced commercial crop and livestock production since the late 1970s to the present. In some countries large-scale deforestation has led to monoculture crop production solely aimed at earning foreign exchange. As a result, prices of locally produced crops are higher compared to imported goods such as rice and flour. Many urban populations in the Pacific are now very much dependent on cheap foreign imports for their daily sustenance. However, according to a recent study by the University of Copenhagen (2007), in the Solomon Islands, the majority of rural people still lives and depends on subsistence food production and fisheries. A multitude of cultivated plants such as; yams (*Dioscorea spp.*), taro (*Colocasia esculenta*) and sweet potatoes (*Ipomoea batata*) and other crops such as bananas (*Musa spp.*) and watermelon (*Citrullus lanatus*) are still part of people's main staple diet.

In the Pacific about 70% of the gross cropped area is geographically located so as to benefit from rains in the summer season (November – April). Production is therefore heavily dependent on the seasonal rainfall. Climate change predictions for the region suggest prolonged variations from the normal rainfall which can be devastating to agriculture. Fiji's experience with the 1997/98 ENSO (El Niño Southern Oscillation) event is a case in point, where losses in the sugar cane industry were around FJ\$104 million while other agriculture losses including livestock death amounted to FJ\$15 million (McKenzie *et al.*, 2005). Flooding and strong winds associated with tropical depressions and cyclones have in the past curtailed agriculture production (Mataki *et al.*, 2007). Tropical Cyclone Ofa in 1990 turned Niue from a food exporting country into one dependent on imports for the next two years (Adger *et al.*, 2007). Such disruptions to food production and the economy may intensify in future, given the projections for more intense tropical cyclones and precipitation variations of up to 14% on both sides of normal rainfall (IPCC, 2007) by the end of the century. More so, in between climate extremes, altered precipitation and increased evapotranspiration (including its intensity as well as temporal and spatial shifts) will also be of concern as these changes take root. The increase in atmospheric carbon dioxide may benefit agriculture but these positive effects are likely to be negated by thermal and water stress associated with climate change (Lal, 2004); and changes in pests' and weeds' voracity and growth respectively; loss of soil fertility and erosion resulting from climatic variability being another problem. Increasing coastal inundation, salinization and erosion as a consequence of sea level rise and human activities may contaminate and reduce the size of productive agricultural lands, and thereby threaten food security at the household and local levels.

Fisheries

Per capita consumption of fish in PICTs is very high by global standards with an average of 70kg of fish consumed per person per year in the early 1990s; and fish exports account for as much as 73% of the total

⁶ In this paper, food sources refer to the productive sectors (agriculture, forestry, fisheries and drinking water) and food imports.

exports of some countries (Barnet, 2007). In 1998, the landed value of tuna fisheries from PICTs' waters was \$US1.9 billion (Gillett, 2002) indicating the economic significance of fisheries to national economies and subsequently their food security. Both oceanic and coastal fisheries are bound to be affected by climate change. The combination of increasing temperatures and sea level rise will result in changes to coastal circulation patterns, thereby affecting nutrient supply, lagoon flushing, coastal erosion, and possibly ocean acidity and coral bleaching (SPREP and PIFs, 2007). These will affect both the reef building capacity of corals as well as the spawning cycles of reef fishes and invertebrates. Increased incidences of ciguatera fish poisoning will also be seen (Adger *et al.*, 2007). Given that coastal fisheries provide a significant source of food and economic security for coastal populations (most Pacific Islanders are coastal dwellers), climate change poses a serious threat to the livelihood of Pacific people. Industrial fishing (oceanic), which is mainly based on tuna, is also known to be related to ENSO, where skipjack and yellowfin tuna are being displaced eastwards during ENSO events and westward in La Niña (Kirby, 2007). Such distributional effects may become more pronounced with projections for more ENSO-like climate and may deprive some PICTs of the much-needed income from the tuna industry. The survival and growth of any fishery is intricately linked to environmental variables such as sea temperature and primary production. As such, the projected increase in sea level, sea surface temperature changes and alteration of the mixing layer thickness will ultimately affect plankton productivity; and this will mostly likely result in the decline of fisheries productivity (Lal, 2004) and food security. Most of the coastal ecosystems on which coastal fisheries depend will be adversely affected. For example, coral reefs that are close to their threshold temperature tolerance will suffer irreversible damage if the seawater temperature exceeds 29.5 °C. There have been widespread coral bleaching during ENSO episodes following threshold crossing. More stormy weather and intense cyclones may render fishing trips unsafe and less productive and consequently affecting fish supply and depriving fisher folks and industries of income.

Forestry

Forest ecosystems are essential component of Pacific Islands' environment and are by nature, highly fragile and vulnerable to external disturbances. Increasing population, impacts of human induced activities (e.g., logging and forest clearance for agricultural activities) and the introduction of invasive species can severely degrade island ecosystems bordering on the margins of ecological collapse. Pressure for global market economies has also seen significant commercial harvesting of natural forest resources as well as subsistence harvesting. Beside the ecological functions of the forests, they are sources for food, income, medicine, fuel and building materials and therefore linked to the overall food security of communities near these "biological warehouses". Wild harvests of edible nuts, fruits, plants and meat from the forests form a significant source of food for Pacific island people. In a region where the delivery of medical services is often limited by physical isolation and affordability, traditional medicines from the forest are often the only barriers between life and death.

Increased atmospheric carbon dioxide may be beneficial in terms of plants' and forests' growth and yield; however this is also dependent on the photosynthetic pathways, moisture, temperature, and nitrogen application (Adger *et al.*, 2007). More specific information on the impacts of climate change on wild harvests and different communities within forests are largely unknown, and therefore weakened our assessment of the overall food security implications of this important food source within a climate change context. However, the increased pressure of human activities on forests could threaten wild harvests, curtail income and destroy traditional medicine and consequently affecting food security at the local level.

Imported food

There is a worrying trend throughout the Pacific today that demand for food is increasingly being serviced by imports. Basic staples such as rice and wheat for flour are key substitutes of traditional diets that are now part and parcel of a Pacific Islander's daily diet. This is a critical situation in terms of food security

and nutritional security, given the volatility of international commodity prices. During the Gulf war, in 1998, the cost of rice in Palau almost doubled from US\$9.00 to US\$16.00 for a 25kg bag (Pers Com. Aitaro, 2008). Currently, in the Solomon Islands, a 20kg bag of rice costs around US\$15-20. Deteriorating terms of trade, rising external debts and inflation plagues the capacity of Pacific islanders to adequately meet their nutritional requirements from imported food alone. The above examples denote that future food security for the Pacific cannot be left solely to dependency on imports. If that is the case, then poverty would increase and the ability of a Pacific nation to deliver on its MDG obligations would be seriously compromised. Moreover, cheap food imports have also contributed to the rise in heart diseases, obesity and other health complications in the Pacific Islands, as such, improvements to local food production are pertinent in strengthening resilience and more so in a changing climate regime.

Drinking water

The five main drinking water sources are; (1) Rain water, (2) Ground water, (3) Surface water, (4) Desalinated water, and (5) Imported drinking water. In most PICTs, not all sources are accessible and available readily to islanders, rendering them extremely vulnerable to natural variability in precipitation patterns or changes in storm tracks. This is particularly true for the atoll states in the region (Salinger *et al.*, 1995). Droughts associated with ENSO events have depleted rainfall collection supplies and the freshwater lenses and parched aquifers on many Pacific islands. For example, in 1998, 40 atolls of the Micronesian sub-region ran out of drinking water supplies during an ENSO event (Tutangata, 1996), resulting in the declaration of a national emergency. In the same year, rainwater tanks in substantial parts of Kiribati dried up and shallow groundwater reserves became brackish (World Bank, 2000). The main island of the Marshall Islands also had access to drinking water for only seven hours every fourteen days, and rationing occurred on all islands in the North Pacific (East-West Center, 2001). Regular tropical cyclones also imperil drinking water supplies. Storm surges have also been known to overtop some small low-lying islands (e.g. some low-lying limestone islands in Ha'apai Group in Tonga), contaminating freshwater lenses with saltwater for months and damaging rainfall collection systems (Falkland and Custodio, 1991 and Falkland 1999). In keeping with climate projections for the future, drinking water supplies will be negatively impacted unless drastic adaptive measures are implemented.

IV. LAND AND MARINE TENURE SYSTEM

Future food security for the Pacific would depend by and large on access to land. Already, agricultural development experts in the Pacific are concerned that changing development priorities have seen the loss of arable agricultural lands to housing, tourism developments and industries (Ratukalou *et al.*, 2000). In Papua New Guinea, large tracts of forests are being cleared to make way for palm oil production, which is proving to be the next generation of fuels developed in many developing countries for global markets. An analysis of the above trend points to a competition between multinational corporations and small holder farmers with limited financial and land resources. With resource owners now better educated and have a better grasp of the value of their land resource, they could be tempted to seek out potential benefits from climate change mitigation at the expense of food security. Revenue flows from carbon markets and biofuels could tempt a change that could evolve into a food security crisis for the region. PICTs are also introducing new land and marine tenure systems' development policies, laws, and regulations mainly to facilitate economic activities (e.g. sea weed and beche-de-mer trade, and tourism development). More often, food security implications of these new policies and legislation are not high in the issues considered. Such changes have indirectly placed and forced many poor Pacific islanders to reduce their

access to productive land for farming and also to some of their traditional fishing grounds, which they normally rely on for their protein supply.

V. CASE STUDIES

In 2007 the FAO Sub-Regional Office for The Pacific Islands in Apia, Samoa commissioned two case studies as a contribution to the understanding of the impacts of climate change on agriculture and food security in the Pacific. The case studies were undertaken in Vanuatu and the Republic of the Marshall Islands (FAO 2007, 2008), illustrating the different circumstances faces by high islands with significant land area (Vanuatu) and atoll countries (Republic of the Marshall Islands).

The case studies acknowledged that the likely impacts of climate change and increased carbon dioxide concentrations in the atmosphere are not well understood. However in both cases the changes are expected to be detrimental to agriculture and food security, particularly in relation to changes in rainfall patterns.

For the Republic of the Marshall Islands (RMI) the case study highlights the importance of reviving subsistence agriculture to support its rapidly growing population. The most important food crops are copra, breadfruit and pandanus. These crops used to be abundant during their seasons but harvests are reported to have been disrupted by climatic extremes such as typhoons and droughts in recent years. Increased preference and reliance on imported foods is putting pressure on the national economy and having implications for nutrition and health.

Being composed of twenty-nine atolls and five low elevation islands, RMI is particularly vulnerable to sea level rise. This and the incidence of extreme events such as droughts and tropical cyclones could result in increased salinity of the soils and freshwater lens, thus impairing food production. There is also increasing pressure on coastal and marine environments, a particular concern given the role of seafood in the diet. Conversely, mariculture is seen as an area having potential for expansion.

The study calls for immediate action to minimise the adverse effects of climate change and sea level rise on the country's already vulnerable atoll environment. The report observes that this "will be a long hard battle" and states that "the international community is duty-bound to assist the RMI with its efforts to adapt to climate change" (FAO 2007).

For Vanuatu, an archipelago of 80 high islands, the case study records that some agricultural crops are already showing signs of stress under current climatic conditions. Water scarce areas and small islands that depend entirely on rainwater and underground water sources are also experiencing severe water shortages. Coastal erosion and inundation are reported from coastal communities and fish poisoning has been an emerging problem in recent years. The report indicates that these problems will be aggravated by any further changes to current climatic conditions, and observes that there is currently limited data to enable Vanuatu to plan effective responses to climate change impacts.

The two case studies illustrate the different conditions faced by Pacific Island Countries according to their geography and human and natural resources. However some common themes can be drawn from the two studies that have wider applicability in the Pacific Islands regions:

- The potential for climate change to impact negatively on agriculture and food security is acknowledged.
- There is a clear need to focus on supporting agricultural production in the context of changing climatic conditions and future climate change scenarios
- The limited human capacity among Pacific Island Countries highlights the need to focus on capacity development
- There is a lack of awareness and information available to governments and communities to assess the potential effects of climate change and make appropriate decisions.
- Importance of coordinated, systematic approach rather than activities carried out in isolation (i.e. mainstreaming food security issues into budget, planning, and related policy areas)...
- Practical responses must be designed to be implemented in a way that is consistent with local capability and circumstances
- There are potential opportunities for increased food in coastal marine area through mariculture/aquaculture
- Real progress can only be made with support from development partners

VI. WHAT HAS BEEN DONE?

Climate can be considered as a valuable natural resource, which is of enormous economic and social importance, but is usually taken for granted. Considering the gravity of the issues involved, PICTs view the impacts of climate variability including extreme weather events, climate change and sea level rise as an impediment to sustainable development in the region. Realising this development dilemma, PICTs have committed themselves to a number of international and regional agreements such as UNFCCC and its Kyoto Protocol, and the Pacific Plan, for addressing climate change impacts within the context of their sustainable development strategies (Koshy, 2005).

In 2005, the Pacific Islands Forum Leaders' meeting adopted the Pacific Islands Framework for Action on Climate Change (PIFACC). PIFACC explicitly recognizes the need to identify vulnerable sectors in order to better design and target adaptation measures. In terms of action on the ground, about 24 projects focusing mainly on climate change adaptation and basic human capacity building have been carried out in the Pacific region⁷ during the last decade. This is a small portfolio of projects in contrast to other regions of the world. Overall, PICTs' response to climate change so far can be described as being, project-based, *ad hoc* and heavily dependent on external resources. Competing priorities, lack of national government

⁷ GEF (Global Environment Facility), 2006: Pacific Islands Adaptation to Climate Change Project (PACC), PDFB Document

commitment, limited capacity and the dominance of international priorities over national ones in the climate change agenda are some of the common justifications for (Nunn, 2007 and Mataki *et al.*, 2007) such feeble response. Internationally driven documents such as the NAPAs and National Communication for the UNFCCC, and regional frameworks (e.g. PIFACC and the Pacific Plan) are pertinent to guide climate change activities; however, national development plans should be the basis of adaptation and mitigation work in PICTs. After all, the salient elements of these documents were supposed to be incorporated into development plans at various levels of governance. The other features of PICTs' climate change response are the limited participation of the private sector, limited mitigation projects, and the dominance of projects led by regional organizations⁸ over projects led by individual countries and territories.

It is worth noting that PICTs with the assistance of CROP⁹ agencies, donors and international agencies have also been working towards improving their food production and economies without clear reference to climate change. In 2002, FAO launched an initiative to help Small Island Developing States review and update their national policies and strategies for food security and agricultural development. In conformity with the Food and Agriculture Organization Plan of Action on Agriculture on Sustainable Agriculture in SIDS, Pacific Island Countries are encouraged to move towards more intensified, diversified and sustainable agriculture in order to create an enabling environment for agricultural intensification and diversification, remove production constraints, and improve domestic and export marketing and processing in the years to come. The intention is to build and/or strengthen national capacities and institutions to accommodate and take advantage of the new international trade regime, strengthen support services to agriculture, forestry and fisheries and provide a coherent framework for sustainable natural resource management and environmental protection in a rapidly changing world. This indicates that even before the threat of climate change came to the fore, food security challenges were already entrenched in PICTs; and some win-win adaptation measures have been implemented. However, these adaptive efforts need to be invigorated and strategically targeted to avoid mal-adaptation.

The development, completion and implementation of the PIFACC Action Plan will contribute to the coordination of activities in the region. The Action Plan is intended to support implementation of the Framework through actions taken in response to meeting the key outcomes under each of Framework principles:

1. Implementing adaptation measures
2. Governance and decision-making
3. Improving our understanding of climate change
4. Education, training and awareness
5. Contributing to global greenhouse gas reduction; and
6. Partnerships and cooperation

The Action Plan is regional in nature, with national activities complemented by regional programming in support. It provides an indicative menu of options for action on climate change. An accompanying matrix will also be developed by the Pacific Climate Change Roundtable in order to provide a clear overview of ongoing and planned activities at the national and regional levels, with responsible agencies or entities, and ensure that interested donor countries and agencies are able to identify initiatives to support, so that

⁸ Secretariat of the Pacific Regional Environment Program (SPREP), the South Pacific Applied Geoscience Commission (SOPAC) and the University of the South Pacific (USP).

⁹ Council of Regional Organisations of the Pacific.

their work aligns to Pacific priorities. By clearly identifying actual existing programmes and projects within the matrix of activities it is expected that national officials and local stakeholders, as well as interested donor countries and partner organizations can ensure greater leverage of resources to the region for climate change work. This will also allow for a clearer alignment between different initiatives.

The re-establishment of the Pacific Climate Change Roundtable in 2008 will also provide for thematic discussion of particular topics such as climate change and food security.¹⁰

VII. WHAT MORE NEEDS TO BE DONE?

Climate change impacts on food security will not be uniform through out PICTs because of differences in the expected climate change between islands, island topography, production systems and economic base. The uniqueness of each PICT must therefore be at the fore of any action implemented to safeguard food security. To this end, PICTs should focus on adaptation and to a lesser extent on mitigation. Adaptation to climate change in each of the food sources will be complex because of the intricate linkages and feedbacks of the climate with the food sources and society, barriers and the economy. In terms of specific adaptation measures, PICTs may need to focus on the win-win measures such as switching to drought-resistant crop varieties¹¹, improving climate information dissemination systems and farm level management, strengthening the enforcement of fisheries and forestry legislation, and eliminating bureaucratic inefficiencies in governments. In addition, the cross-sectional vulnerabilities of different stakeholders and sectors of the society must also be factored when responding to the impacts of climate change. For example, Pacific women are mostly responsible for gleaning inshore waters and reefs for fish, shellfish and other marine products (Per.com, Tawake, 2008), the projections for more intense tropical cyclones and rise in sea surface temperature will negatively impact inshore fisheries and affect women's source of income and more importantly hamper household food supply especially in the rural areas.

Pacific Island countries need to seriously review their agriculture, forestry, fisheries and drinking water development policies in light of new information on climate change from the IPCC. Nations that have pushed for monoculture crop production for foreign markets will need to assess their food security potential. It is well established that diversified economies and strong agricultural sectors will fare better under climate change scenarios. Thus, getting an enabling environment in place, getting markets working, putting social protection in place, and strengthening research and development (R&D) will enable the agriculture sector and agricultural livelihoods to be more resilient, as well as stimulating wider economic growth. In other words, Income generation and food production in vital food sources such as agriculture will have to be strengthened to match the growth in human population which is presently at a regional average of 2% per annum (ESCAP and PIFS, 2008).

The mainstreaming of climate change knowledge at every level of planning is imperative, and this must be followed by appropriate action at field or people level. For example, the forging/strengthening of genuine partnerships with the farmers in providing them the best available guidelines on choice of crop varieties, soil and water management options under changed environmental conditions to avert the risk of crop failures which are crucial for food security and economy of the region. In addition, when addressing the issue of food security, four climate change parameters ought to be carefully monitored for current and future planning purposes. They are temperature (warm and cold nights), precipitation, sea level change and extreme events. Extreme events need to be carefully monitored considering the devastation it can

¹⁰ SPREP press releases and circular detailing Action Plan, 2008

¹¹ Secretariat of the Pacific Community (SPC) is working in this area – in establishing a climate ready collection in the Centre for Pacific Crops and Trees (CePaCT). This collection will be available for farmers to access.

inflict on ill-prepared PICTs. More importantly, this climate information must be analyzed and made into communication products easily understood by farmers in the field and fisher folks in the sea.

Future Initiatives

While much has been done in relation to climate change in the Pacific Islands region, it has focused on generic aspects of climate change, largely through environment departments and officials. This has led to a high level of engagement in the international climate change policy negotiations, and meeting reporting requirements under UNFCCC (including production of National Communications, NAPAs etc). Relatively little effort has been devoted to raising the level of awareness and understanding in the key food production sectors, and less on the creating an integrated approach incorporating the full range of stakeholders and policies that contribute to food security in a changing climate.

The realisation that climate change (and the policy responses to climate change) can have profound negative impacts on food security has raised issues of critical importance for the Pacific Island Countries. The discussion above has highlighted the need for action to address climate change / food security issues in the Pacific Islands context.

The need for support from the international community has been identified in the case studies discussed above. This is consistent with the Bali Action Plan (the " Bali Roadmap") adopted by UNFCCC COP 13 in December 2007. The Roadmap identifies enhanced action on adaptation as a key area for cooperative action, in light of the need for urgency in addressing climate change. The Roadmap sets out the need for international cooperation to support urgent implementation of adaptation actions including through capacity building and response strategies, integration of adaptation actions into sectoral and national planning, specific project and programmes and other initiatives to reduce vulnerability. The Roadmap also highlights the urgent and immediate needs of small island developing states and least developed countries.

Against this background, the following have been identified as specific areas where support from the international community is needed:

- Raising awareness and understanding of climate change and its potential impacts on food production and food security, particularly in sectors beyond the environment departments and NGOs that have previously been at the forefront of climate change discussions.
- Mainstreaming climate change across government agencies, to ensure that food security is addressed in a way that includes all the relevant government stakeholders, and is recognized in both national and sectoral planning and budgeting.
- As a key element or product of mainstreaming; design of cross-sectoral policies to support domestic food production (incorporating agriculture, fisheries, water, trade/tariff policy, appropriate incentives etc)
- Intensive efforts at capacity building for agriculture are needed across the Pacific Islands region - focusing on climate change impacts and adaptation
- Similar capacity building efforts are needed for integrated coastal management, taking into account future climate change scenarios to limit adverse effects and optimize food production opportunities.
- Support for programmes and projects that target agricultural (including seafood) production to promote food production/security in light of climate change focusing on specific agricultural (including mariculture/aquaculture) products and processes.

VIII. CONCLUSION

Climate change is already affecting PICTs. Climate variations and extremes have disrupted food production, water supply and economies of PICTs. Climate projections for the future although coarse for islands, are bleak and will reduce food security especially at household level. The primary food sources (Agriculture, Fisheries and Forests) and water will all be impacted by climate change and in most cases, these impacts will be negative. In terms of action against climate change and to cope with its impacts, PICTs are at various stages of the continuum from the ratification of UNFCCC to the implementation of concrete mitigation and adaptation measures. The exact magnitude and nature of the climate change impacts on food sources are relatively unknown in PICTs. However, the strengthening of the adaptation enabling environment (e.g. Legislation and policy adjustments relating to food sources, coordination amongst and across key stakeholders and R&D) and implementation of adaptation measures (e.g. expanding seed banks and increasing investments in primary food sources) must start now with a focus on win-win measures.

BIBLIOGRAPHY

1. Adger, W.N., Agrawala, S., Mirza, MMQ, Conde, C., O'Brien, K., Pulhin, J., Pulwarty, R., Smit, B. and Takahashi, K. 2007. Assessment of adaptation practices, options, constraints and capacity. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 717-743.
2. *Barnet, J., 2008. Food Security and climate change in the South Pacific, Pacific Ecologist 14 Winter 2007*
3. Currathers, P. and Bishop, B., 2004. CBDAMPIC National Report. Prepared as part of the Canadian funded and SPREP implemented Capacity Building for the Development of Adaptation Measures project. Cook Islands Environment Service. Unpublished Report.
4. Climate Impacts Group (CIG)., 2001. *CIG Research Summary*. University of Washington. Available at <http://www.jisao.washington.edu/PNWimpacts/index.html>. Accessed on February 2008.
5. Dorward, A. and Kydd, J., 2003. 'Implications of Market and Coordination Failures for Rural Development in Least Developed Countries' Paper presented at the Development Studies Association Annual Conference, Strathclyde University, Glasgow, 10-12 September 2003.
6. ESCAP and PIFS. 2008. Concept Note: Addressing Vulnerabilities Issues of Pacific Island Countries: Climate Change, Food Security and Water Management, Consultative Meeting among Executive Heads of Subregional Organizations and ESCAP, Twelfth Session, 12 March 2008 Noumea, New Caledonia
7. East-West Center. 2001. Pacific Island Regional Assessment of the Consequences of Climate Variability and Change. East-West Center, Honolulu, Hawaii, Chapter 2, p. 27.
8. Ellis, F. 2000. Rural Livelihoods and Diversity in Developing Countries, Oxford University Press, Oxford.
9. Falkland, A., and E. Custodio. 1991. "Hydrology and water resources of small islands: A practical guide." UNESCO contribution to the International Hydrological Programme.
10. Falkland, A. 1999. "Tropical island hydrology and water resources: Current knowledge and future needs." Second Colloquium on Hydrology and Water Management in the Humid Tropics, March 21-24, Panama.
11. Fan, S., Zhang, X., and Rao, N. 2004. 'Public Expenditure, Growth and Poverty Reduction in Rural Uganda' DSGD Discussion Paper No. 4, IFPRI, Washington, DC.
12. FAO 2003. 'World Agriculture towards 2015/2030: An FAO Perspective'. Rome: Food and Agriculture Organisation of the United Nations.

13. FAO 2007. "An assessment of the impact of climate change on agriculture and food security in the Pacific: A case study in Vanuatu". Prepared for FAO SAPA Apia, Samoa by Muliagatele Joe Reti, Pacific Environment Consultants Ltd (PECL).
14. FAO 2008. "An assessment of the impact of climate change on agriculture and food security in the Pacific: A case study in the Republic of the Marshall Islands". Prepared for FAO SAPA Apia, Samoa by Muliagatele Joe Reti, Pacific Environment Consultants Ltd (PECL).
15. Fischer G., Shah, M., Tubiello, F.N., and van Velhuizen, H., 2005. 'Socio-economic and climate change impacts on agriculture', *Philosophical Transactions of the Royal Society B* 360: 2067 – 2083
16. Fischer G, Shah, M. and van Velhuizen, H., 2002. *Climate Change and Agricultural Vulnerability*. A special report prepared by the International Institute for Applied Systems Analysis as a contribution to the World Summit on Sustainable Development, Johannesburg 2002.
17. Gillett, R.D., 2002. *Pacific island fisheries: regional and country information*. Asia-Pacific Fishery Commission, FAO Regional Office for Asia and the Pacific, Bangkok. RAP Publication 2002/13
18. Hay, J.E., Mimura, N., Campbell, J. Fifita, S., Koshy, K., McLean, R.F., Nakalevu, T., Nunn P. and N. de Wet., 2003. *Climate Variability and Change and Sea-level Rise in the Pacific Islands Region - A Resource Book for Policy and Decision Makers, Educators and Other Stakeholders*. South Pacific Regional Environment Programme, Apia, Samoa. 108p.
19. IPCC. 2007. Summary for Policymakers. In S. Solomon, D. Qin, M. Manning, Z. Chen, M.C. Marquis, K. Averyt, M. Tignor and H.L. Miller (eds), *Climate Change 2007: The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK and New York, USA.
20. IPCC. 2007a. 'Climate Change 2007: Climate Impacts, Adaptation and Vulnerability', Working Group II to the Intergovernmental Panel on Climate Change Fourth Assessment Report, DRAFT technical summary 2006, Geneva: Intergovernmental Panel on Climate Change.
21. IPCC. 2007b. 'Climate Change 2007: The Physical Science Basis: Summary for Policymakers' Working Group I to the Intergovernmental Panel on Climate Change Fourth Assessment Report, Geneva: Intergovernmental Panel on Climate Change.
22. IPCC WG2 Chapter 16 and Hales et al. 1999
23. IPCC WG2 SPM March 2007.
24. Kirby, D.S., 2007. *Interactions between ocean climate and tuna fisheries in the western and central Pacific ocean: understanding variability and predicting change*, IPCC TGICA Expert Meeting: Integrating Analysis of Regional Climate and Response Options, Westin Resort, Nadi, Fiji June 20-22
25. Koshy K., 2005. Small Island Developing States – The Mauritius Declaration and Strategy, *Tiempo*, 56, Pp 3-7.

26. Koshy, K, Lal, M & Mataka, M., 2005. *Sustainable Development and the Pacific Island Countries*, Pacific Centre for Environment & Sustainable Development, University of the South Pacific, Suva, Fiji
27. Lal, M., 2004. *Climate Change in Small Island Developing Countries of the South Pacific*, Fijian Studies, Vol. 2, 1, pp15-31
28. Lehodey, P., 2000. 'Impacts of climate change on tuna fisheries in the Tropical Pacific Ocean', Draft, Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia; Becken (2004), 'How tourists & tourism experts perceive CC & climate offsetting schemes'; Singh, U., D.C. Godwin, and R.J. Morrison, 1990: 'Modeling the impact of climate change on agricultural production in the South Pacific'.
29. Mataka, M; Koshy, K; Nair, V., 2007. "Top-down, Bottom-up: mainstreaming adaptation in Pacific island townships". Ed. Leary, N et al., *Climate Change and Adaptation*, Earthscan, pp264-278.
30. McKenzie, E. Kaloumaira, A. and Chand, B. 2005 "The Economic Impacts of Natural Disasters in the Pacific" Technical Report, University of the South Pacific (USP) and the South Pacific Applied Geoscience Commission (SOPAC), Suva. A Binger, A. and Duncan, C.F.N. 2007 reported that the cost of Cyclone Heta was over NZ\$50 m, or about 200 years of Niue's annual export value.
31. Niue PACC National Report.
32. Nunn, D, P., 2007. *Responding to the Challenges of Climate Change in the Pacific Islands: Management and Technological Imperatives*, IPCC TGICA Expert Meeting, Integrating Analysis of Regional Climate and Response Options, July 20-24, Westin Resort Denarau Island, Nadi, Fiji
33. Personal Communication. 2008. Aitaro, J.. Protected Area Network Coordinator (PAN), Office of the Environmental Response and Coordination, Palau.
34. Personal Communication, 2008. Tawake, L., Project Coordinator, Climate change adaptation in rural communities of Fiji, USP.
35. Prowse, M. and Braunholtz-Speight, T., 2007. *The first Millennium Development Goal, agriculture and climate change*. Overseas Development Assistance Opinion Paper, 111 Westminster Bridge Road, London SE1 7JD.
36. Ratukalou et al., 2000. Unpublished Report, SPC
37. Regional Co-ordination Centre for Research and Development of Coarse Grains, Pulses, Roots and Tuber Crops in the Humid Tropics of Asia and the Pacific (CGPRT Centre). 2000. *Integrated Report: Food Security Strategies for selected Pacific Island Countries*. Proceedings of the Workshop on Food security in the South West Pacific December 12-13, 2000.
38. Relief Web, 2008. *Press Release on Tropical cyclone Gene rehabilitation*, Accessed from <http://www.reliefweb.int/rw/RWB.NSF/db900SID/MUMA-7BT93K?OpenDocument> on 14th February 2008.

39. Ruosteenoja, K., Carter, T.R., Jylha, K. and Tuomenvirta, H., 2003. *Future climate in world regions: an intercomparison of model-based projections for the new IPCC emissions scenarios*. The Finnish Environment 644, Finnish Environment Institute, Finland.
40. Salinger, M.J., Basher, R.E., Fitzharris, B.B., Hay, J.E., Jones, P.D., MacVeigh, J.P. and Schmidely-Leleu, I, 1995. "Climate trends in the South-West Pacific." *International Journal of Climatology*, Vol. 15, p. 285.
41. Slater, R., 2007 Climate Change: Implications for DFID's Agriculture Policy. Paper prepared for DFID Renewable Natural Resources and Agriculture Team. London: ODI Slater, R. and Peskett, L. 2007 Climate Change, Agricultural Growth and Poverty Reduction. Paper prepared for DFID Renewable Natural Resources and Agriculture Team. London: ODI
42. Slater, R., Peskett, L., Ludi, E. and Brown, D., 2007. Climate change, agricultural policy and poverty reduction – how much do we know?
43. SPC. 2004. *Pacific Islands regional millennium development goals report* / prepared by the Secretariat of the Pacific Community in cooperation with the United Nations and the UN/CROP MDG Working Group, Noumea, accessed from http://www.spc.int/mdgs/MDGReport/Reg_report.htm
44. SPREP and PIFs. 2007. Joint paper on climate change presented at the Secretariat of the Pacific Community 5th Meeting of the Conference of the Parties of the Community. Apia. 12-13th November, 2007.
45. Tutangata, T.I., 1996. *Vanishing Islands, Our Planet*. Available at http://www.ourplanet.com/imgversn/103/06_van.htm.
46. University of Copenhagen, Danish Meteorological Institute, University of the South Pacific and the Solomon Islands Meteorological Service Centre. 2007. Sustainable Resource Use or Imminent Collapse? Climate Livelihood and Production in the Southwest Pacific, CLIP Research Project Final Report, Funded by the Bikubenfonden through Danish Expedition Foundation; Knud Hojgaards Fond, COWIfonden, Brodrene Hartmann's Fond, Danish Social Science Research Council.
47. World Bank. 2000. Cities, Seas, and Storms. Papua New Guinea and Pacific Island County Unit. The World Bank, Washington, D.C., Vol. 4, p. 25.